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(54) **Apparatus and method for controlling the reproduction of recorded information.**

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DE-A-3 245 439
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US-A-4 423 497</p> | <p>(73) Proprietor: STAAR SOCIETE ANONYME
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Description

The present invention relates to apparatus for reproducing information carried by a carrier, such as a record disc.

Background Art:

Information is recorded on record discs on one or more spiral tracks and is read by a reproduction element, such as a magnetic head or cell, or light ray. Mechanical and/or electronic means ensure relative movement between the reproduction element and the carrier to permit the detection of the information recorded on the carrier. In the case of record players for compact discs, the disc is driven in a rotational movement about its axis of symmetry while the reproduction element is displaced radially relative to the disc from the interior to the periphery. These movements are related in such a manner that the reproduction element follows the information track and the recovery of the information carried by the disc takes place at a constant linear reproduction speed in the reproduction mode.

As a result of damage, soiling of the carrier and/or the reproduction head, or poor detection or error in detection, a break may occur in the rhythm of the progression of the recovery of information recorded along the information track due to drop-out of the reproduction head from following the recorded track and the head may get "stuck" at the same position, with the result that the apparatus "repeats" information.

Means have already been proposed for controlling the reproducing element according to a manually set reproduction mode in order to obtain special effects in particular in video reproduction such as still picture, slow motion or quick motion reproduction.

Such special reproductions apparatus are disclosed in documents US-A-4.423.497 and GB-A-2.082.823).

However the kick pulse producing circuit specially designed to perform said special reproduction modes cannot be used to solve the problems of repeated information reproduction from record discs due to poor or erroneous detection of the position of the reproducing element during normal reproduction rhythm.

Furthermore, the prior art documents are relating to video disc playback apparatus which are adapted to recover information signals such as pulse synchro signals, vertical synchro signals and video image signals which are recorded separately and of the analog type. The means for following and sensing each of the pictures which are recorded separately the one after the other in a normally numbered progression sequence along the successive convolutions of a spiral track are consequently adapted to said specific video signals.

The phenomenon of repeating information is particularly unpleasant and uncontrollable when encountered in the reproduction of sound recorded on audio discs provided with digital

signals, and the main object of the present invention is to eliminate the phenomenon by providing simple and reliable apparatus and circuitry to maintain the rhythm of the progression of the recovery of the information recorded along the tracks of the carrier.

To achieve this object, the invention is embodied in an apparatus, as defined in claim 1.

Brief Description Of The Drawings:

The preferred form of the invention and its best mode will be described as applied to record players for compact discs. Other characteristics of apparatus embodying the subject invention will be apparent from the description of two preferred embodiments given below, in a non-limiting manner, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic illustration of the operation of a record player for compact discs;

Figure 2 is an illustration of an electronic circuit diagram for carrying out the invention with the apparatus illustrated in Figure 1; and

Figure 3 is a diagram of an instruction program.

Best Mode For Carrying Out The Invention:

A record player 10 comprises a chassis 12 to which are fixed a motor 14 and a guiding and driving system 16 for the reproduction head 20 which, in the case described, is an optical system comprising a laser.

The drive spindle of the motor 14 carries a turntable 26 on which a record disc 28 is positioned and held by means of a clamping magnet 30. With application of the appropriate voltage, the motor 14 ensures rotation of the record disc 28.

The guiding and driving system 16 comprises a guide surface 32 permitting the sliding of the reproduction head 20, and a motor 34 driving an endless drive screw 36, ensuring displacement of the head 20 with which it is engaged.

Motors 14 and 34 are connected to a control circuit 38, controlled by a microprocessor 70 operating under program control in the reproduction mode, to control the rotary speed of the record disc 28 and the position of the reproduction head 20 so that the recovery of information carried on the surface of the record disc takes place at a linear reproduction speed.

With compact discs, the information is recorded along a spiral extending from the interior of the disc to its periphery.

The reproduction of information is effected by a laser beam detecting the presence or absence of depressions on the record and generating a series of 1s and 0s which, when they have been decoded and processed, reproduce the recorded audio signal.

The following of the track is also effected by means of a laser beam according to different methods, the common principal of which, however, is to measure the quantities of light reflected on a plurality of photoelectric cells 39 and then to process the result of these measurements to

ensure that the reproduction beam is kept on the track.

In compact discs, the digital signals which are recorded along the tracks also include time information signals. According to a standard format, the digital signals are recorded in blocks, each block containing signals representing minutes and seconds from a starting point of the location of the block. Other types of information are typically included, for example, in the case of music recordings, relating to the duration of the disc and to each of the pieces of music which are recorded along the track. Once the digital signals have been decoded, the time information is transmitted to a numerical display device 40, enabling the user to know precisely, inter alia, the instantaneous position of the information being reproduced.

As illustrated in Figure 1, the instantaneous position of the information being reproduced is 2 minutes, 45 seconds.

When the detection of the information carried by the record disc is either incomplete or erroneous due to surface defects, for example, scratches or dirt, the following of the track by the reproduction head becomes only approximate and errors then occur which can result in a failure of the recovery of the information to maintain the progression for accurate reproduction of recorded information. Errors are detected by the circuitry and corrections then effected.

According to the present invention, imminent drop-out from the normal progression is detected either by determining that the number of corrections effected by the appropriate circuits within a given period of time exceed a predetermined threshold or, as in the most preferred embodiment, by verifying that the display of the instantaneous position is continuously updated according to a preset rhythm (in the present case, second by second).

For carrying out this most preferred embodiment, the signal controlling the numerical display is diverted to the input 41 of a bistable circuit 42, which has a time constant incorporating a time-based reference value circuit 43, and the output 44, which transmits a signal if the instantaneous position has not been updated within a predetermined time (Figure 2). In the present example, the updating of the display takes place every second and the time constant has a value of 1.3 seconds.

The signal generated when the display has not been updated within 1.3 seconds is then transmitted to a circuit 46 of the astable type, which generates a pulse having a predetermined characteristic. This pulse is then transmitted, by means of interface circuit 50, to the control circuit 38 to control displacement of the reproduction head 20. In a very simple embodiment, this signal may be a pulse of given duration which controls rotation of the drive screw 36 to ensure a given displacement of the reproduction head 20.

With a laser reproduction unit, the focusing lens, through which pass the incident rays reflected by the surface of the disc, is mounted on

a moving contact controlled by circuit 38 by means of coils 52, the displacement of which beyond a given value controls the rotation of the endless drive screw 36. This displacement of the lens ensures detection of information over a given distance and the endless screw regularly undergoes a slight rotation to bring the moving contact into successive positions.

In this exemplary embodiment it is an advantage to apply the signal originating from circuit 50 to the circuit controlling the lens to guarantee a given displacement of the laser beam relative to the instantaneous position (for example, 2 seconds).

If, despite displacement of the reproduction head 20, circuit 38 again transmits a pulse representative of a break in the rhythm of the progression of the recovery of information, this pulse is added to the previous ones in verification counting circuit 54, which delivers a pulse when the count has reached a given number (for example, 8) within a predetermined period of time (for example, 16 seconds). By means of gate 62, pulse 64 blocks the transmission of the control pulse of the astable circuit 46, and, as a result of its characteristic, causes a greater displacement of the reproduction head by means of circuit 50. In the most preferred embodiment, it "kicks" the reproduction head to the beginning of the following piece of music.

Such a laser "kick" is selected because, from experience, it is considered that the large number of errors found within this predetermined period of time indicates, with satisfactory probability, that it will not be possible to effect satisfactory production at this part of the disc. As soon as the mode of reproduction at normal speed is abandoned, circuit 42 is rendered inactive.

Figure 3 illustrates diagrammatically a set of logical instructions realizing the steps previously described in such a manner as to use a microprocessor 70.

A time-based circuit controlled by the microprocessor 70 compares the progression of the recovery of the information with a reference value and, when the result of this comparison exceeds a predetermined value, such as 0.3 seconds, an instruction controls the displacement of the reproduction head by a given value.

As in the previous example, a verification counter is then incremented by one unit.

If the value of this counter exceeds the number 8 within a period of time T (for example, 16 seconds), the counter is then reset to zero and a pulse is transmitted to the microprocessor 70 to cause it to effect the positioning of the reproduction head at the beginning of the following piece, as shown in Figure 2.

Claims

1. Apparatus which reproduces information recorded along a track of a record disc (28), the information including primary information and successive real time information signals quantita-

tively and cumulatively representing successive instantaneous positions of the primary information in real time from a starting point, said apparatus including a reproducing element (20) which recovers the information recorded along the track; motor-driven means (14, 34) providing relative movement between the record disc (28) and said reproducing element (20), controller means (38) for controlling said motordriven means (14,34) to either locate said reproducing element (20) so that it follows the information track and to maintain a substantially linear reproduction speed enabling said reproducing element to recover the information recorded along the information track at a normal playback rhythm or move it along the track of a predetermined distance, characterized in that said controller means (38) comprise means (42) including a time-based reference value circuit (43) for automatically and continuously monitoring the rhythm of the progression of the information recovered from the track by said reproducing element (20) by comparing each interval of time between successive real time information signals decoded from recovered information with the time-based reference value, said monitoring means (42) also including means (46) for delivering a control signal when a predetermined difference indicative of a break occurs in the rhythm of the progression of the recovered information based upon the comparison; and means (50) transmitting said control signal to said controller means (38) for powering a first adjustment in the relative movement between the record disc (28) and the reproducing element (20) so that it locates the position of the reproducing element beyond the break in order to restore the normal rhythm of progression of the recovered information.

2. Apparatus according to claim 1, said controller means (38) including circuit means (54) for counting, within a predetermined period of time, the number of control signals delivered by said monitoring means (42) and for generating a signal to said controller means (38) to make an adjustment having a magnitude larger than said first adjustment in the relative movement between the record disc (28) and said reproducing element (20) if this number exceeds a predetermined number.

3. Apparatus according to claim 1, said controller means (38) including means (46) responsive to the control signal ensuring that the first adjustment of the reproducing element (20) in relation to the record disc (28) is of a predetermined amplitude.

4. Apparatus according to claim 1, wherein said motor-driven means includes means (14) for rotating the record disc (28) and means (34) for displacing said reproducing element (20), and wherein said reproducing element is a laser beam unit.

5. Apparatus according to claim 4 wherein optical advance of the laser beam of the unit is produced by a movable lens through which it

passes and/or by the displacement of the unit itself.

6. Apparatus according to claim 5 wherein the control signal for correcting the relative movement of the record disc and the reproducing element to restore the rhythm of the progression of the recovered real time information is applied to circuits (38,52) controlling the optical advance of the laser beam.

7. Apparatus according to claim 2 wherein the recorded information is in the form of successive pieces of music and the signal generating a larger magnitude than said first adjustment in the relative movement between the record disc (28) and the reproducing element (20) locates the position of the reproducing element (20) at the beginning of the following piece of music.

8. A method for monitoring and correcting the relative movement of a reproducing element and a record disc having information recorded along a track of the record disc, the information including primary information and real time information quantitatively and cumulatively representing progression of instantaneous positions of the primary information in real time from a starting point, the recorded information being recovered during the displacement of the reproducing element along the track during said relative movement which is controlled by means including motor-driven means to either locate said reproducing element so that it follows the information track and to maintain a substantially linear reproduction speed enabling said reproducing element to recover the information recorded along the information track at a normal playback rhythm or move it along the track of a predetermined distance, characterized by the following steps:

— automatically and continuously monitoring the rhythm of the progression of the real time information recovered from the track by the reproducing element by comparing each time interval between successive instantaneous positions decoded from recovered information with a time-based reference value;

— delivering a control signal when a difference of predetermined value indicates a break in the rhythm of the recovered information based upon the comparison;

and

— transmitting said control signal to said controller means for powering a first adjustment in the relative movement between the record disc and the reproducing element so that it locates the reproducing element beyond the break in order to restore the rhythm of the progression of the recovered information.

Patentansprüche

1. Vorrichtung zur Wiedergabe von Information, die längs einer Spur einer Aufzeichnungsplatte (28) aufgezeichnet ist, wobei die Information primäre Information und aufeinanderfolgende Echtzeitdatensignale umfaßt, die quantita-

tiv und kumulativ aufeinanderfolgende augenblickliche Positionen der primären Information in Echtzeit von einem Anfangspunkt aus darstellt, die Vorrichtung ein Wiedergabeelement (20) aufweist, das die längs der Spur aufgezeichnete Information wiedergibt, eine motorisch angetriebene Einrichtung (14, 34) zur Erzeugung einer Relativbewegung zwischen der Aufzeichnungsplatte (28) und dem Wiedergabeelement (20), eine Steuereinheit (38) zur Steuerung der motorisch angetriebenen Einrichtung (14, 34), um entweder das Wiedergabeelement (20) derart zu positionieren, daß es der Informationsspur folgt und eine im wesentlichen lineare Wiedergabegeschwindigkeit aufrecht erhält, die es dem Wiedergabeelement gestattet, die längs der Informationsspur aufgezeichnete Information mit einem normalen Abspielrhythmus zu wiedergeben oder sie längs der Spur eine vorgegebene Strecke zu bewegen, dadurch gekennzeichnet, daß die Steuereinheit (38) eine Vorrichtung (42) umfaßt, die eine mit Zeitbasis arbeitende Bezugswertschaltung (43) enthält, um automatisch und kontinuierlich den Rhythmus des Vorrückens der aus der Spur vom Wiedergabeelement (20) wiedergegebenen Information zu überwachen, indem jedes Zeitintervall zwischen aufeinanderfolgenden, aus den wiedergegebenen Daten decodierten Echtzeitdaten mit dem die Zeitbasis aufweisenden Bezugswert verglichen wird, die Überwachungsvorrichtung (42) ferner eine Vorrichtung (46) zur Abgabe eines Steuersignals enthält, wenn ein vorgegebener Unterschied als Zeichen einer Unterbrechung im Rhythmus des Vorrückens der wiedergegebenen Information abhängig vom Vergleich auftritt; und daß eine Vorrichtung (50) das Steuersignal auf die Steuereinheit (38) überträgt, um eine erste Einstellung in der Relativbewegung zwischen der Aufzeichnungsplatte (28) und dem Wiedergabeelement (20) zu betreiben, so daß die Steuereinheit die Position des Wiedergabeelements jenseits der Unterbrechung feststellt, um den normalen Rhythmus des Vorrückens der wiedergegebenen Information wiederherzustellen.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Steuereinheit (38) eine Schaltungsanordnung (54) enthält, um innerhalb einer vorgegebenen Zeitspanne die Anzahl von Steuersignalen zu zählen, die durch die Überwachungsvorrichtung (42) abgegeben werden, und um für die Steuereinheit (38) ein Signal zu erzeugen, um eine Einstellung vorzunehmen, deren Wert größer als die erste Einstellung in der Relativbewegung zwischen der Aufzeichnungsplatte (28) und dem Wiedergabeelement (20) ist, falls diese Anzahl eine vorgegebene Anzahl überschreitet.

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Steuereinheit (38) eine Vorrichtung (46) aufweist, die auf das Steuersignal anspricht und gewährleistet, daß die erste Einstellung des Wiedergabeelements (20) relativ zur Aufzeichnungsplatte (28) eine vorgegebene Amplitude hat.

4. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die motorisch angetriebene Einrichtung eine Einrichtung (14) enthält, um die Aufzeichnungsplatte (28) zu drehen und eine Einrichtung (34), um das Wiedergabeelement (20) zu verschieben, wobei das Wiedergabeelement eine Laserstrahleinheit ist.

5. Vorrichtung nach Anspruch 4, dadurch gekennzeichnet, daß der optische Vorschub des Laserstrahls der Einheit mittels einer beweglichen Linse erzeugt wird, durch welche der Laserstrahl hindurchtritt und/oder durch die Bewegung der Einheit selbst.

6. Vorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß das Steuersignal zur Korrektur der Relativbewegung zwischen Aufzeichnungsplatte und Wiedergabeelement zur Wiederherstellung des Rhythmus des Vorliegens der wiedergegebenen Echtzeitdaten Schaltungen (38, 52) zugeführt wird, die den optischen Vorschub des Laserstrahls steuern.

7. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die aufgezeichnete Information in Gestalt einander folgender Musikstücke vorliegt und das Signal, das einen größeren Wert als die erste Einstellung in der Relativbewegung zwischen der Aufzeichnungsplatte (28) und dem Wiedergabeelement (20) erzeugt, die Position des Wiedergabeelements (20) am Beginn des folgenden Musikstücks festlegt.

8. Verfahren zur Überwachung und Korrektur der Relativbewegung eines Wiedergabeelements und einer Aufzeichnungsplatte, die Information längs einer Spur derselben aufgezeichnet hat, wobei die Information primäre Information und Echtzeitdaten aufweist, die quantitativ und kumulativ das Vorrücken der augenblicklichen Positionen der primären Information in Echtzeit ab einem Ausgangspunkt darstellen, die aufgezeichnete Information während der Bewegung des Wiedergabeelements längs der Spur während der Relativbewegung wiedergegeben wird, die mittels einer Einrichtung gesteuert wird, die eine motorisch angetriebene Einrichtung enthält, um entweder das Wiedergabeelement derart zu positionieren, daß es der Informationsspur folgt und eine im wesentlichen lineare Wiedergabegeschwindigkeit beibehält, die es dem Wiedergabeelement gestattet, die längs der Informationsspur aufgezeichnete Information bei einem normalen Abspielrhythmus wiederzugeben oder es längs der Spur um eine vorgegebene Strecke zu bewegen, gekennzeichnet durch folgende Schritte:

— automatische und kontinuierliche Überwachung des Rhythmus des Vorrückens der aus der Spur durch das Wiedergabeelement wiedergegebenen Echtzeitdaten, indem jedes Zeitintervall zwischen aufeinanderfolgenden augenblicklichen Positionen, die aus den wiedergegebenen Daten decodiert wurden, mit einem, eine Zeitbasis aufweisenden Bezugswert verglichen wird;

— Abgabe eines Steuersignals, wenn ein Unterschied vorbestimmter Größe eine Unterbrechung im Rhythmus der wiedergegebenen Daten abhängig von dem Vergleich anzeigt; und

— Übertragung des Steuersignals zur Steuereinheit, Betreiben einer ersten Einstellung in der Relativbewegung zwischen der Aufzeichnungsplatte und dem Wiedergabeelement, so daß es das Wiedergabeelement jenseits der Unterbrechung festlegt, um den Rhythmus des Vorrückens der wiedergegebenen Information wieder herzustellen.

Revendications

1. Appareil reproduisant l'information enregistrée le long d'une piste d'un disque d'enregistrement (28), l'information comportant une information primaire et des signaux d'information successifs en temps réel représentant de manière quantitative et cumulative des positions instantanées successives de l'information primaire en temps réel à partir d'un point de départ, le dit appareil comportant un élément reproducteur (20) qui capte l'information enregistrée sur la piste; un dispositif entraîné par moteur (14, 34) produisant un mouvement relatif entre le disque d'enregistrement (28) et le dit élément reproducteur (20), un dispositif régulateur (38) pour commander le dit dispositif entraîné par moteur (14, 34), soit pour positionner le dit élément reproducteur (20) de manière à ce qu'il suive la piste d'information et pour maintenir une vitesse de reproduction substantiellement linéaire permettant au dit élément reproducteur de capter l'information sur la piste d'information à un rythme normal de reproduction, soit pour le déplacer le long de la piste d'une distance prédéterminée, caractérisé en ce que le dit dispositif régulateur (38) comporte un dispositif (42) comprenant un circuit à valeur de référence sur base temporelle (43) pour surveiller de façon automatique et continue le rythme de la progression de l'information captée à partir de la piste par le dit élément reproducteur (20) en comparant chaque intervalle de temps entre les signaux d'information en temps réel successifs décodés à partir de l'information captée avec la valeur de référence, le dit dispositif de surveillance (42) comprenant également un dispositif (46) pour fournir un signal de commande lorsque, sur base de la comparaison, une différence prédéterminée indiquant une interruption se présente dans le rythme de la progression de l'information captée; et un dispositif (50) qui transmet le dit signal de commande au dit dispositif régulateur (38) pour actionner un premier ajustement du mouvement relatif entre le disque (28) et l'élément reproducteur (20) de sorte qu'il fixe la position de l'élément reproducteur au-delà de l'interruption pour restaurer le rythme normal de progression de l'information captée.

2. Appareil selon la revendication 1, le dit dispositif régulateur (38) comprenant un circuit (54) pour compter, dans une période de temps prédéterminée, le nombre de signaux de commande fournis par le dit dispositif de surveillance (42) et pour produire un signal vers le dit dispositif régulateur (38) afin d'assurer un ajustement ayant une amplitude supérieure à celle du pre-

mier ajustement du mouvement relatif entre le disque (28) et le dit élément reproducteur (20) si ce nombre dépasse une valeur prédéterminée.

3. Appareil selon la revendication 1, le dit dispositif régulateur (38) comportant un dispositif (46) sensible au signal de commande assurant que le premier ajustement de l'élément reproducteur (20) par rapport au disque (28) possède une amplitude prédéterminée.

4. Appareil selon la revendication 1, dans lequel le dit dispositif entraîné par moteur comporte un dispositif (14) pour faire tourner le disque (28) et un dispositif (34) pour déplacer le dit élément reproducteur (20), et dans lequel le dit élément reproducteur est une unité à rayon laser.

5. Appareil selon la revendication 4, dans lequel l'avance optique du rayon laser de l'unité est produit par une lentille mobile au travers de laquelle il passe et/ou par le déplacement de l'unité elle-même.

6. Appareil selon la revendication 5, dans lequel le signal de commande pour corriger le mouvement relatif du disque et de l'élément reproducteur afin de restaurer le rythme de la progression de l'information en temps réel captée est appliqué à des circuits (38, 52) contrôlant l'avance optique du rayon laser.

7. Appareil selon la revendication 2, dans lequel l'information enregistrée se trouve sous la forme de morceaux de musique successifs et le signal donnant lieu à une amplitude plus grande que celle du premier ajustement du mouvement relatif entre le disque (28) et l'élément reproducteur (30) fixe la position de l'élément reproducteur (20) au début du morceau de musique suivant.

8. Méthode pour surveiller et corriger le mouvement relatif d'un élément reproducteur et d'un disque d'enregistrement portant une information enregistrée le long d'une piste du disque d'enregistrement, l'information comportant une information primaire et une information en temps réel représentant de manière quantitative et cumulative la progression de positions instantanées de l'information primaire en temps réel à partir d'un point de départ, l'information enregistrée étant captée durant le déplacement de l'élément reproducteur le long de la piste pendant le dit mouvement relatif qui est commandé par des moyens comprenant un dispositif entraîné par moteur soit pour positionner le dit élément reproducteur de manière à ce qu'il suive la piste d'information et pour maintenir une vitesse de reproduction substantiellement linéaire permettant au dit élément reproducteur de capter l'information sur la piste d'information à un rythme normal de reproduction, soit pour le déplacer le long de la piste d'une distance prédéterminée, caractérisé par les étapes suivantes:

— surveillance automatique et continue du rythme de la progression de l'information en temps réel captée à partir de la piste par l'élément reproducteur en comparant chaque intervalle de temps entre les positions instantanées successives décodées à partir de l'information captée avec une valeur de référence basée sur le temps;

— émission d'un signal de commande lorsque, sur base de cette comparaison, une différence d'une valeur prédéterminée indique une interruption dans le rythme de l'information captée, et

— transmission du dit signal de commande au dit dispositif régulateur pour actionner un pre-

mier ajustement du mouvement relatif entre le disque d'enregistrement et l'élément reproducteur de sorte qu'il positionne l'élément reproducteur au-delà de l'interruption afin de restaurer le rythme de la progression de l'information captée.

10

15

20

25

30

35

40

45

50

55

60

65

7

FIG.1

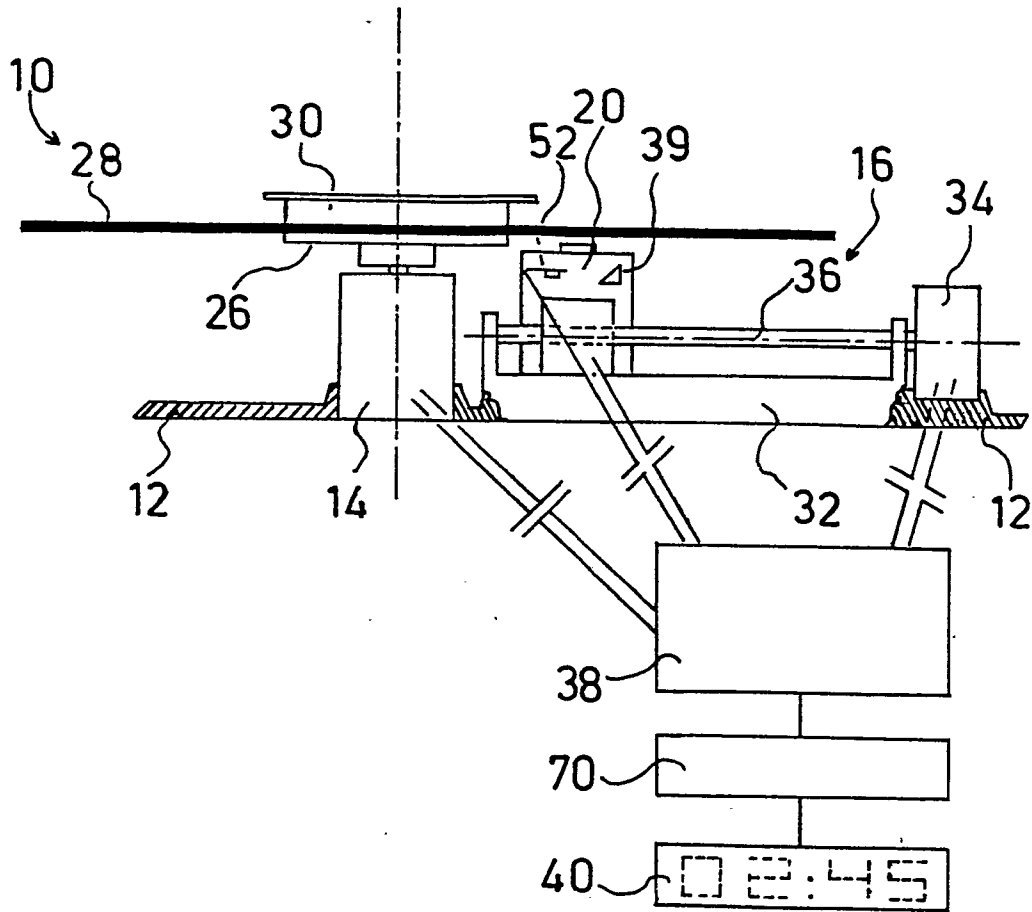


FIG. 2

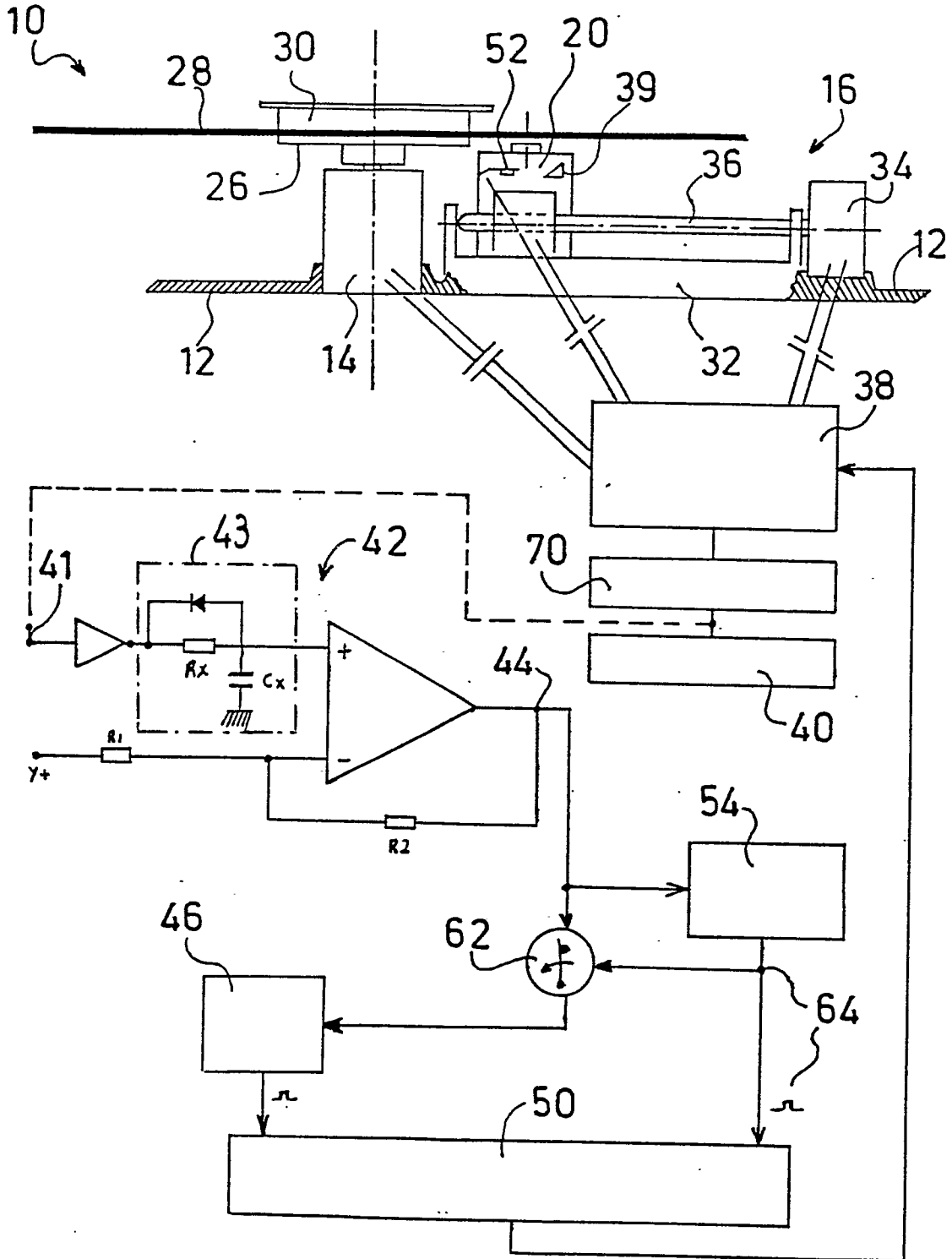


Figure 3

